Polarised charged-current DIS paper

http://arxiv.org/abs/1309.5327

Submitted to PRD

Thomas Burton, EIC Task Force Meeting, 2013-09-26

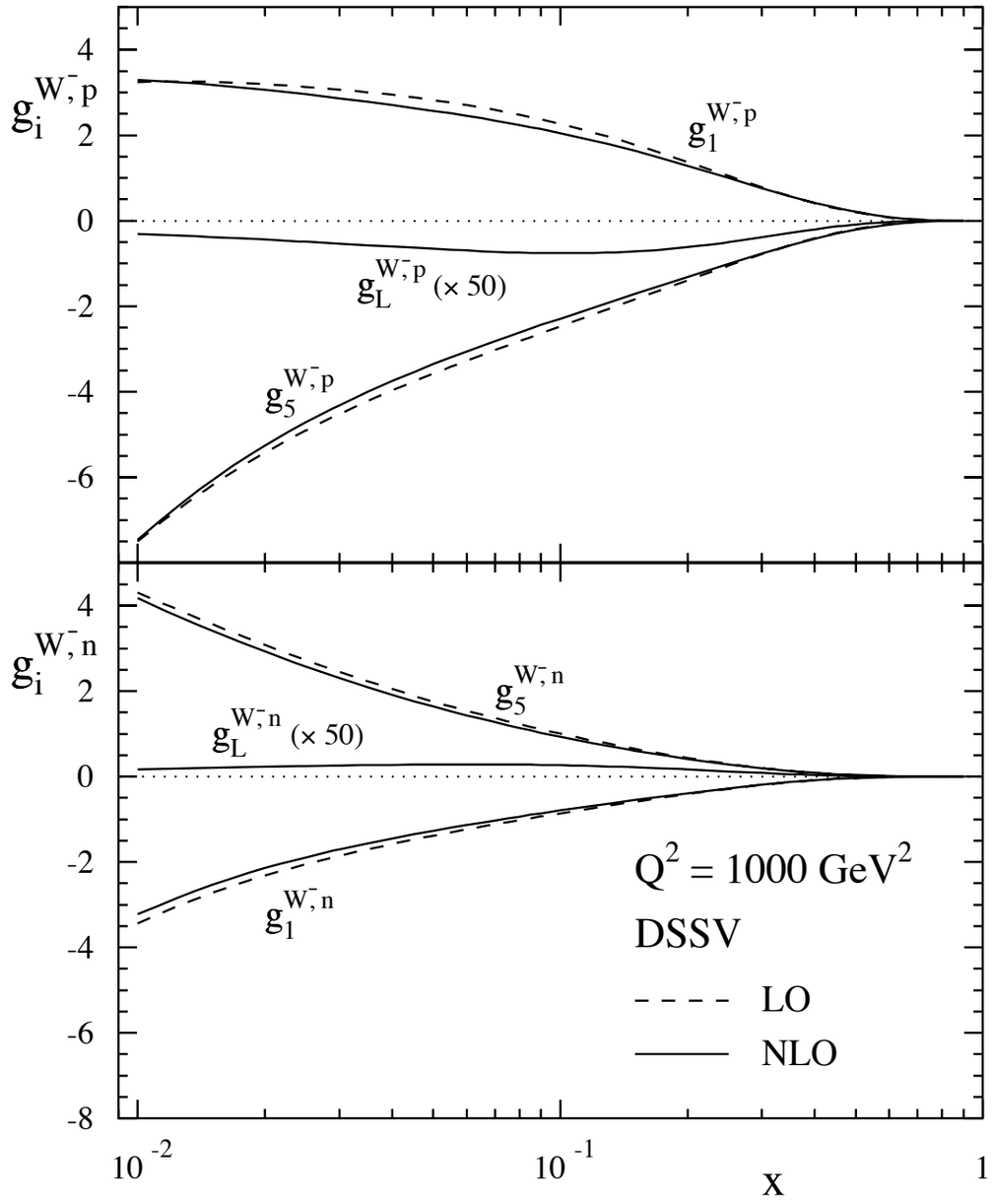
Charged Current DIS

- CC DIS asymmetries:
  - Different flavour combinations than regular DIS

$$g_1^{W^-,p}(x) = \Delta u(x) + \Delta\bar{d}(x) + \Delta c(x) + \Delta\bar{s}(x)\,,$$
$$g_5^{W^-,p}(x) = -\Delta u(x) + \Delta\bar{d}(x) - \Delta c(x) + \Delta\bar{s}(x)$$

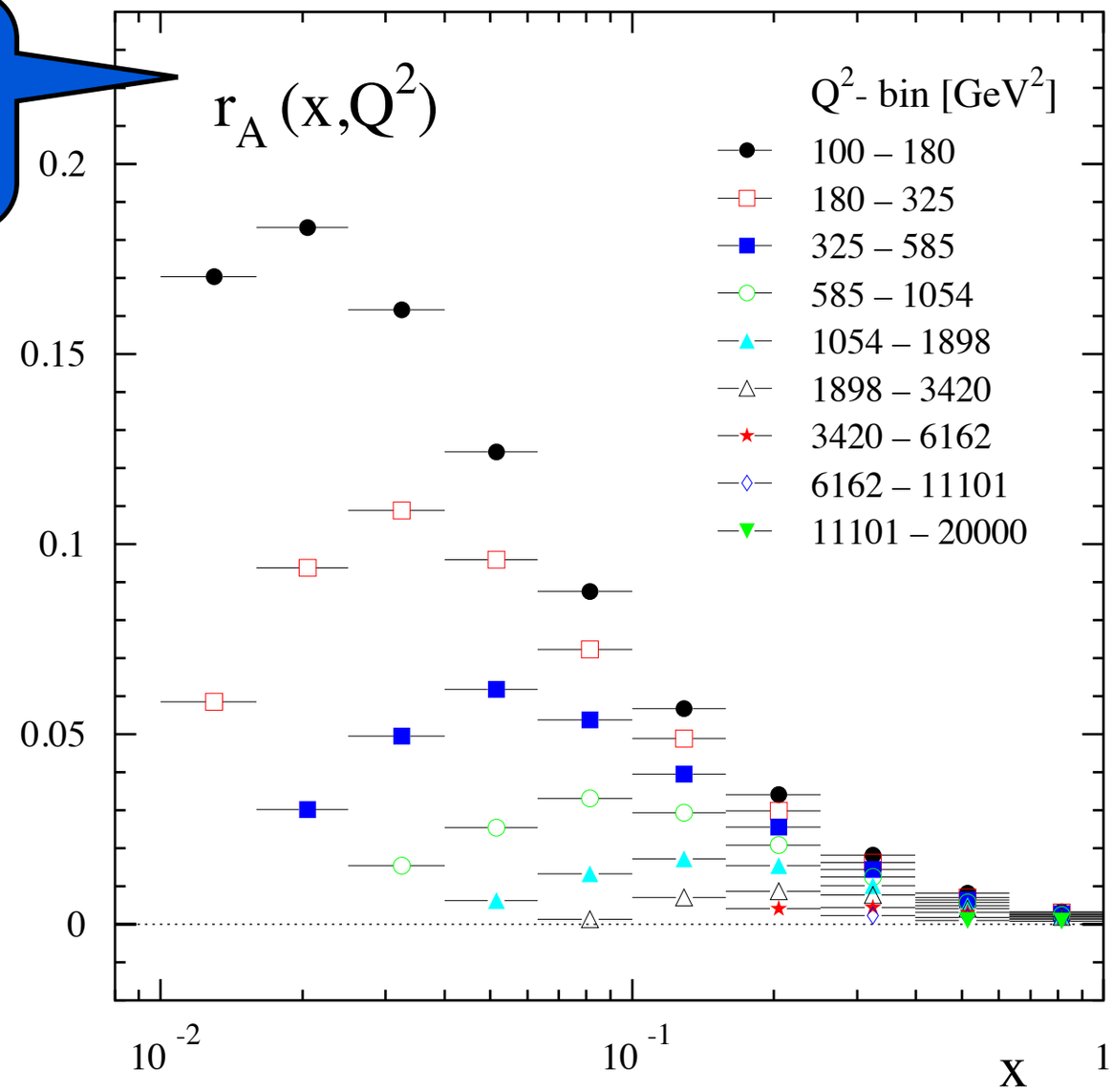
  - Flavour-separated q and anti-q helicity PDFs
- Use e^+ or neutron for other flavour combinations

Spin-dependent CC cross section related to structure functions



DJANGOH updated

Radiative correction factors for single-spin asymmetry

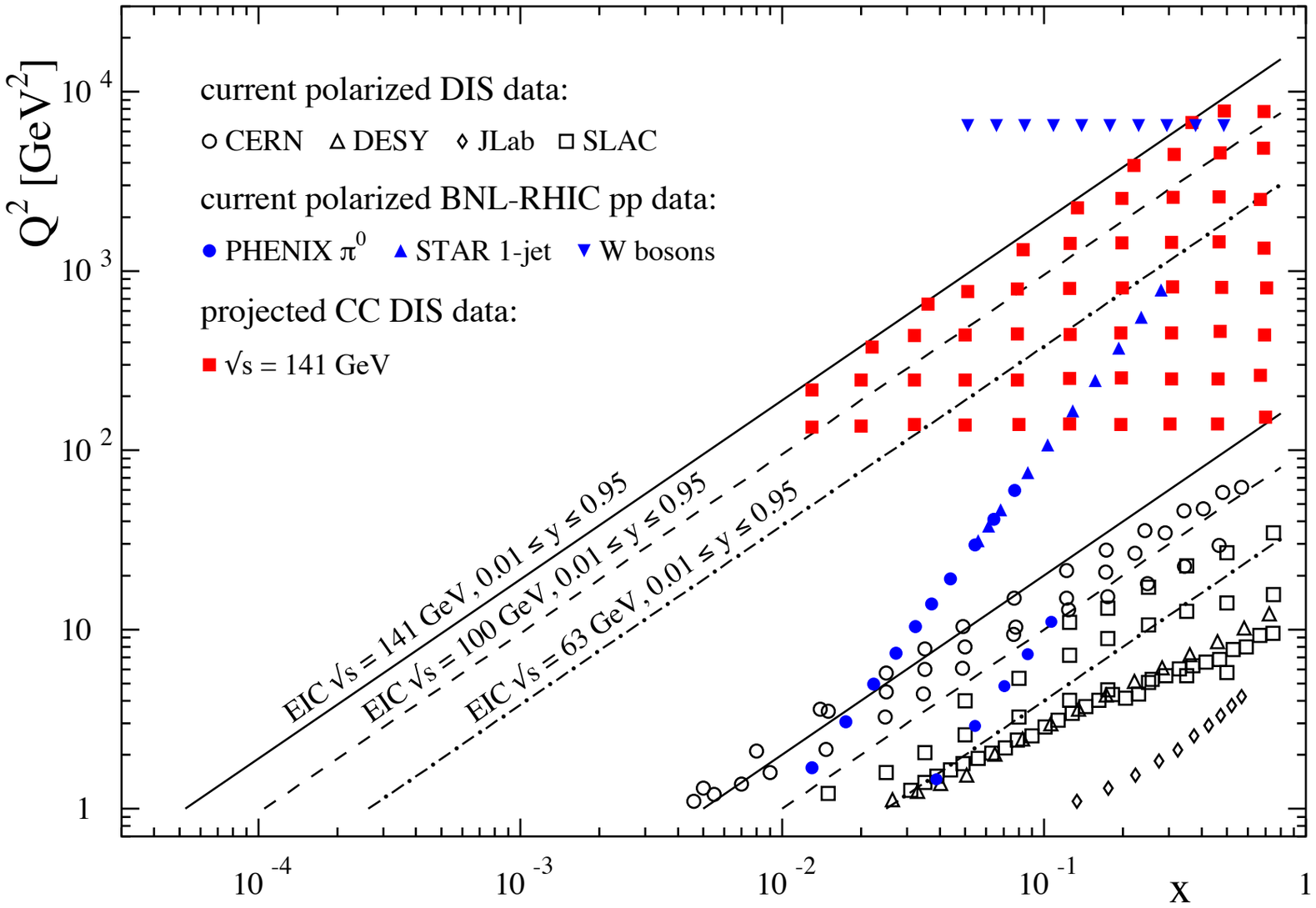


- Polarised nucleons
- Includes radiative effects

$$r_\sigma = d^2\sigma^{W^-,p}|_{\mathcal{O}(\alpha_{em}^3)} / d^2\sigma^{W^-,p}|_{\mathcal{O}(\alpha_{em}^2)} - 1$$

- Try it yourself:
  - http://wwwthep.physik.uni-mainz.de/~hspiesb/djangoh/djangoh.html
  - https://wiki.bnl.gov/eic/index.php/DJANGOH
  - /afs/rhic.bnl.gov/eic/PACKAGES/DJANGOH-4.6.10

Kinematics



- Used 20 x 250
  - s = 141 GeV
  - Extends existing range vs. e.g. W programme
- $Q^2 > 100$ (see later)

Jacquet-Blondel method

- CC: unmeasured final-state lepton
  - kinematics: use hadronic final-state

$$y_{JB} = \frac{\sum_i (E_i - p_{z,i})}{2E_e}, \quad Q^2_{JB} = \frac{p^2_{T,h}}{1 - y_{JB}}, \quad x_{JB} = \frac{Q^2_{JB}}{y_{JB}\, S}$$

- Need to estimate validity given
  - radiative corrections
  - detector performance

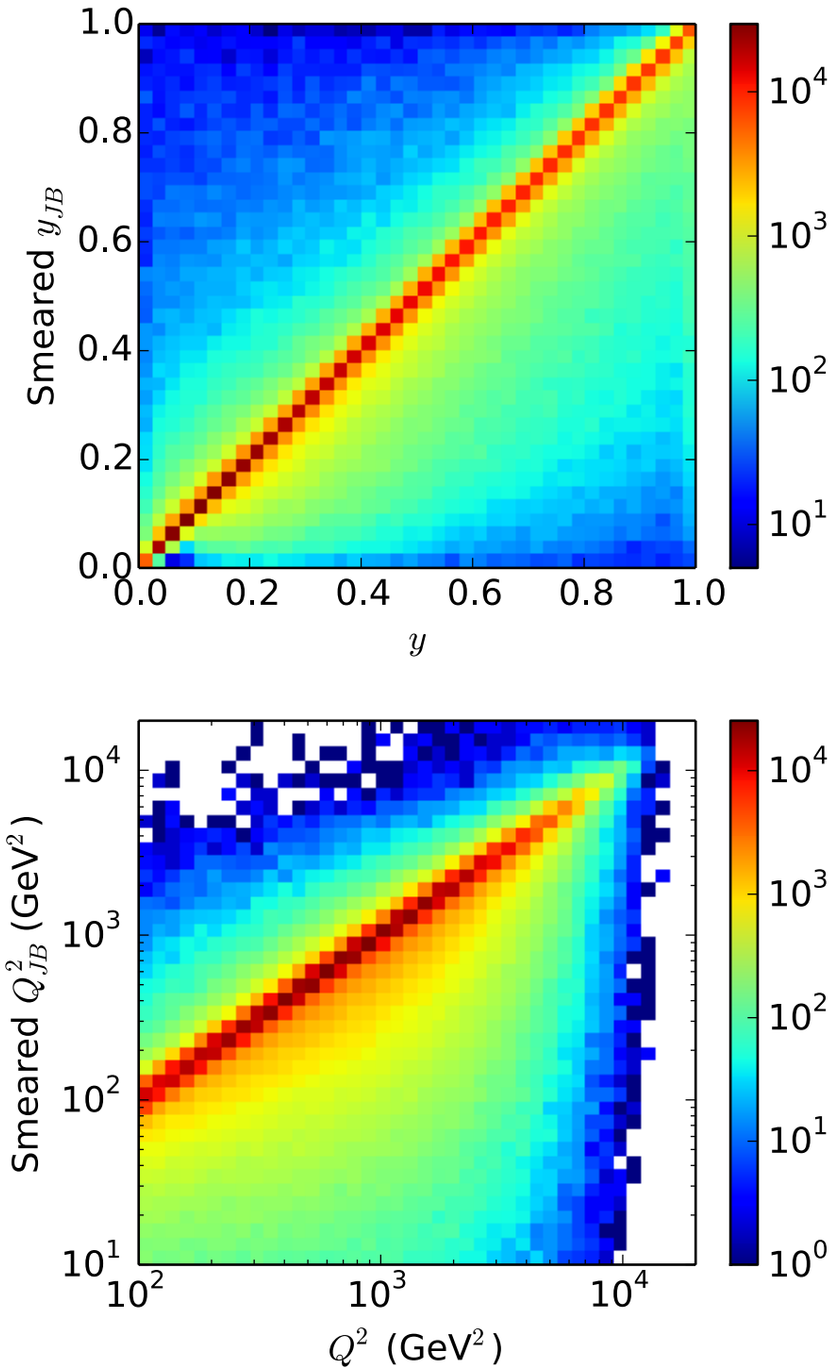
Detector performance

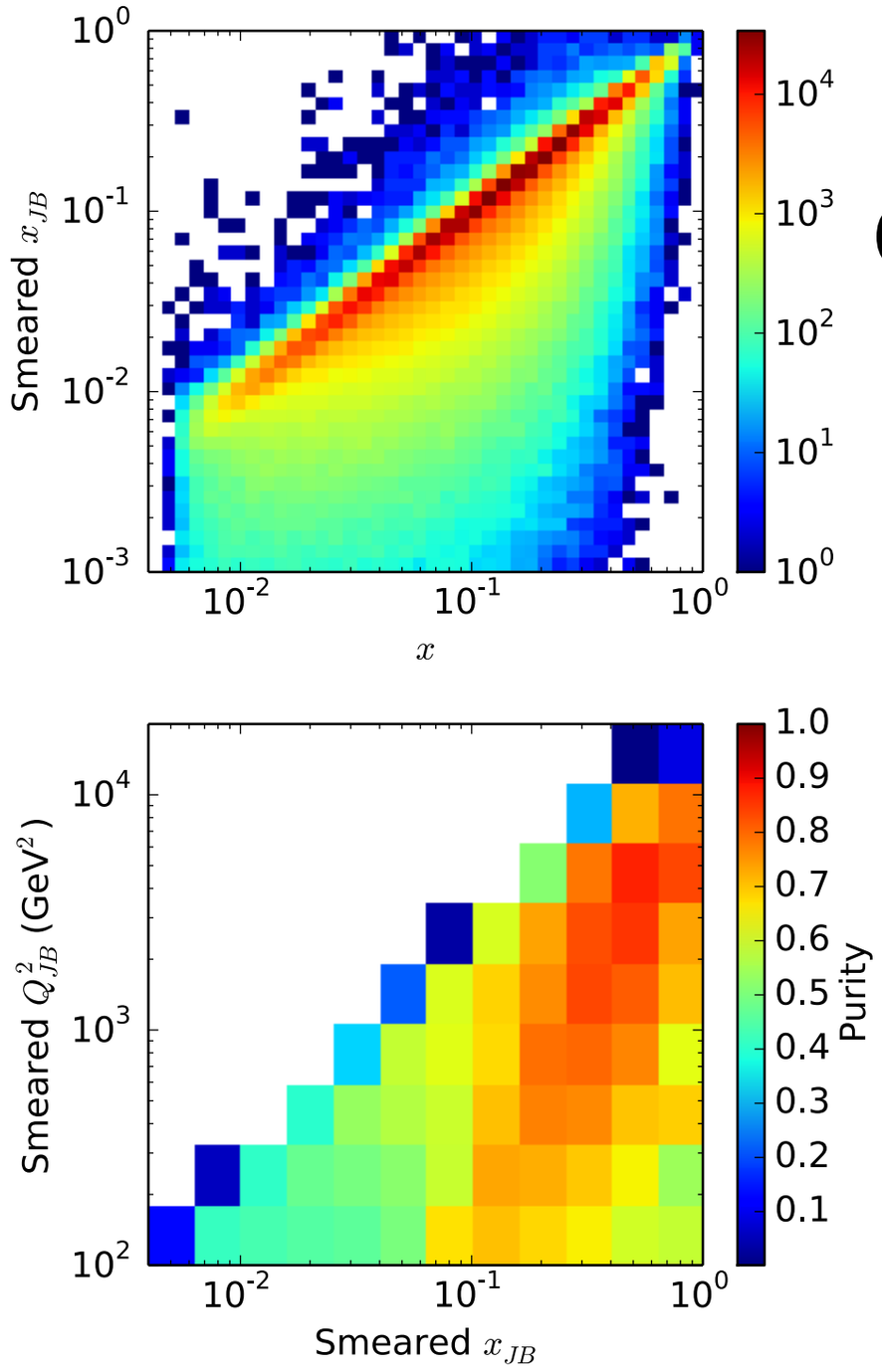
- Detector resolutions:
  - momentum: eicroot (-3 < η < 3)
  - ECal: 1.8% / √E (-4.5 < η < -2)
  - ECal: 12% / √E (-2 < η < 4.5)
  - HCal: 38% / √E (2 < η < 4.5)

< few %

- Ignore angle resolution, particle misidentification
- Input parameterisations to eic-smear

Jacquet-Blondel method



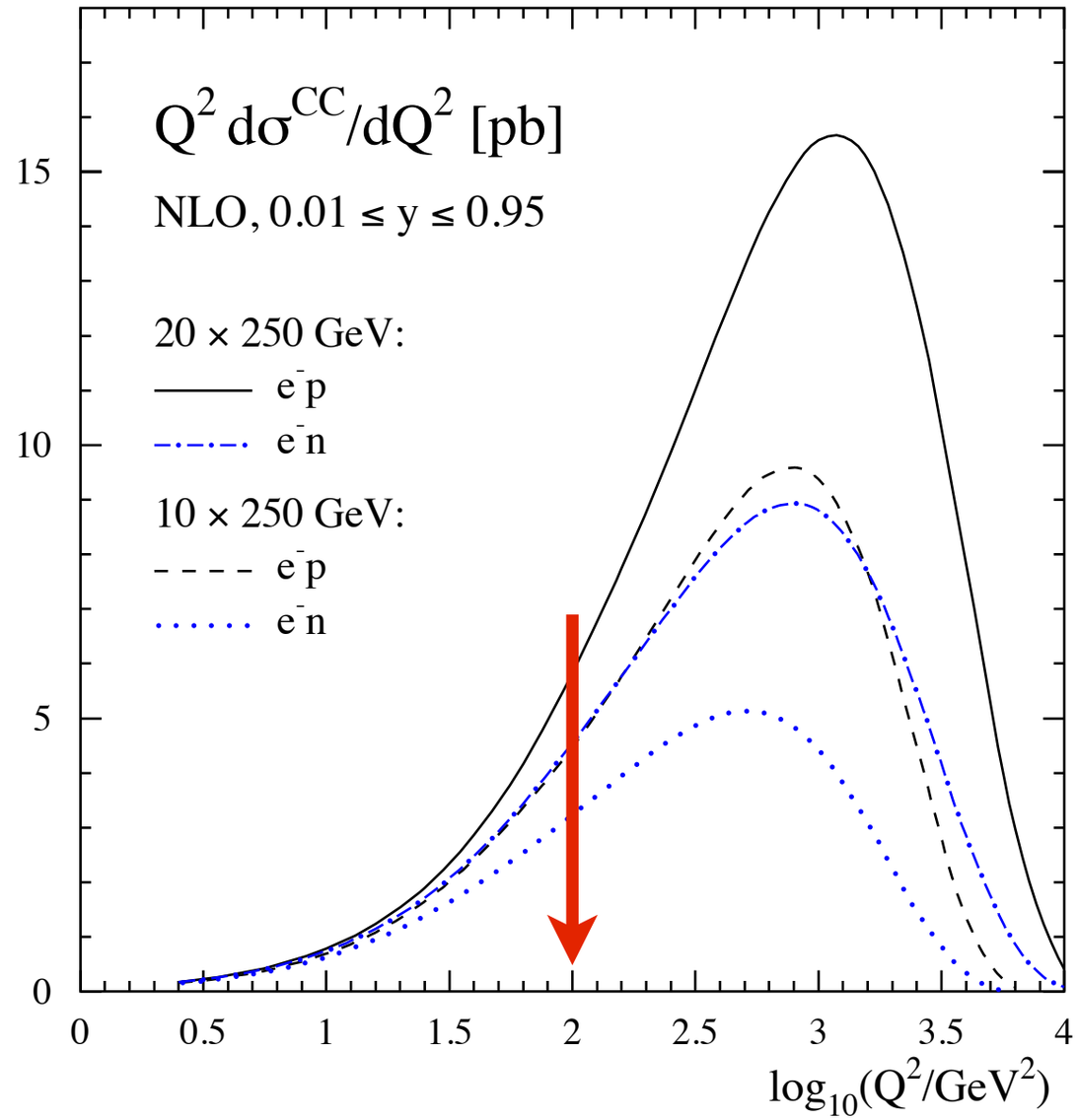


Good correlation in all quantities

$$\text{Purity} = \frac{N_{gen} - N_{out}}{N_{gen} - N_{out} + N_{in}}$$

High Q^2

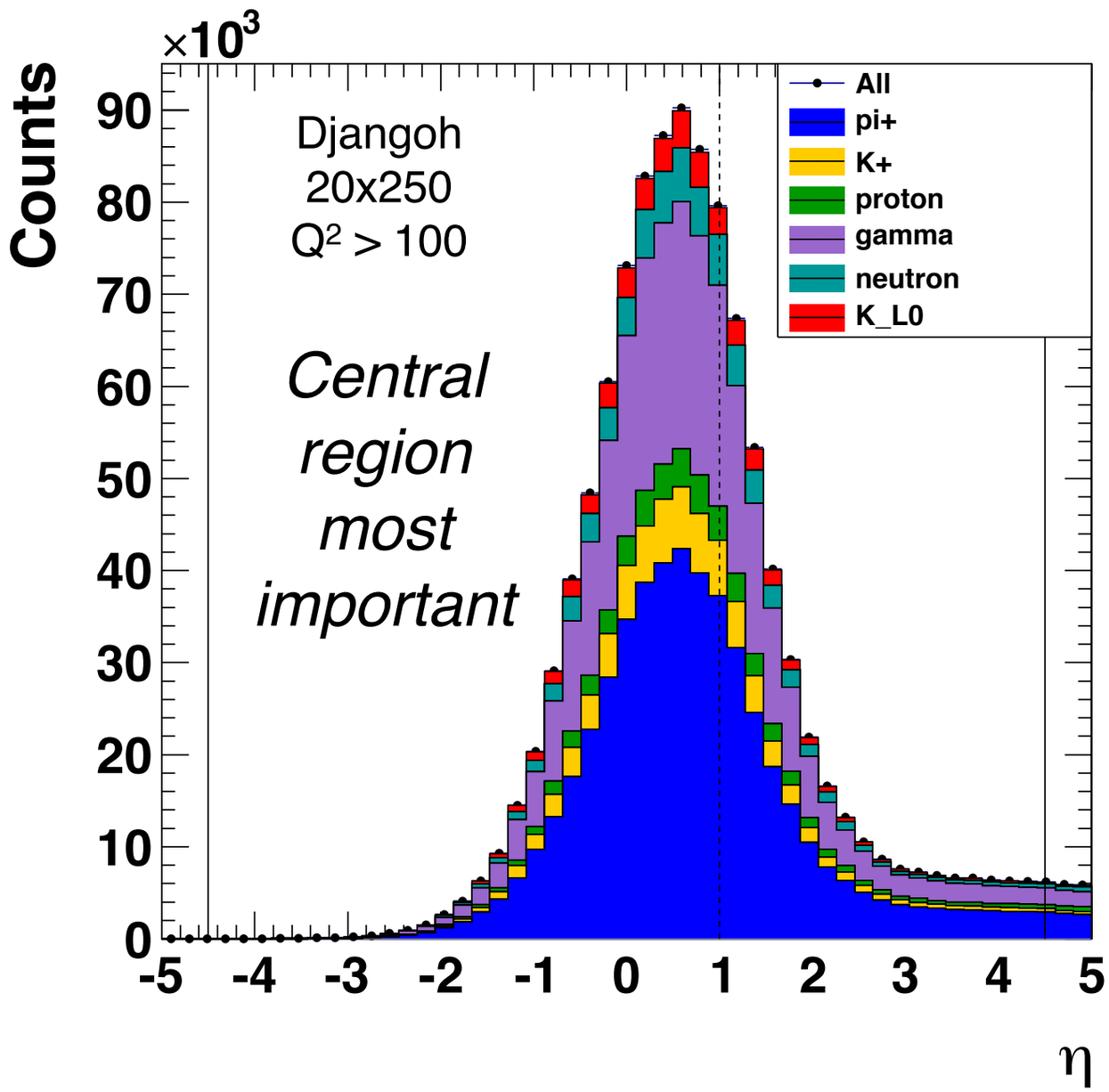
- Simulated **$Q^2 > 100$**
- Most σ at high Q^2
- JB method doesn't do so well at small Q^2 due to losses down beam pipe

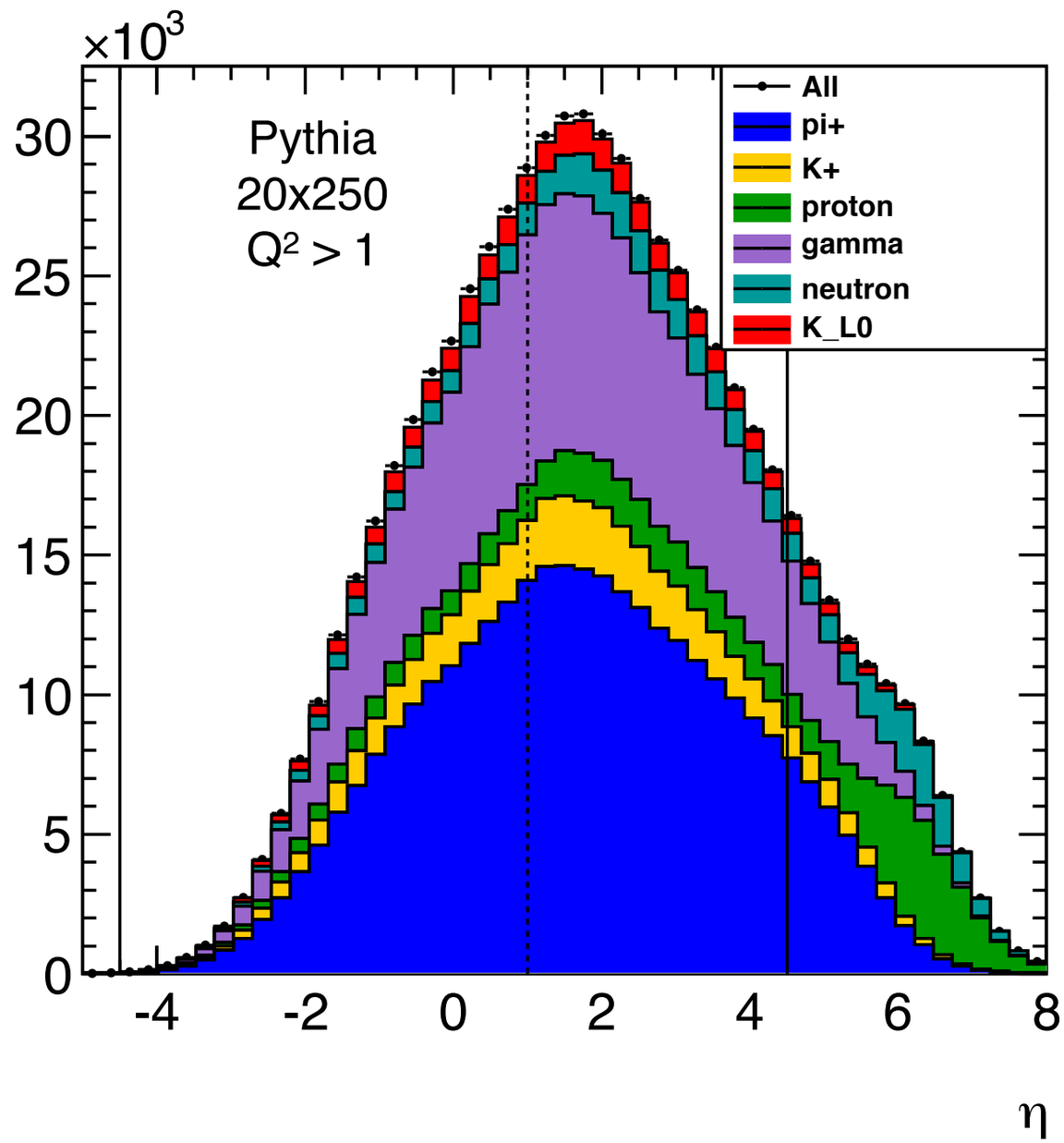


$Q^2_{JB} \sim \text{sum}(p_T)$

Q^2 "kick" gives more particles in central region

counts weighted by p_T:





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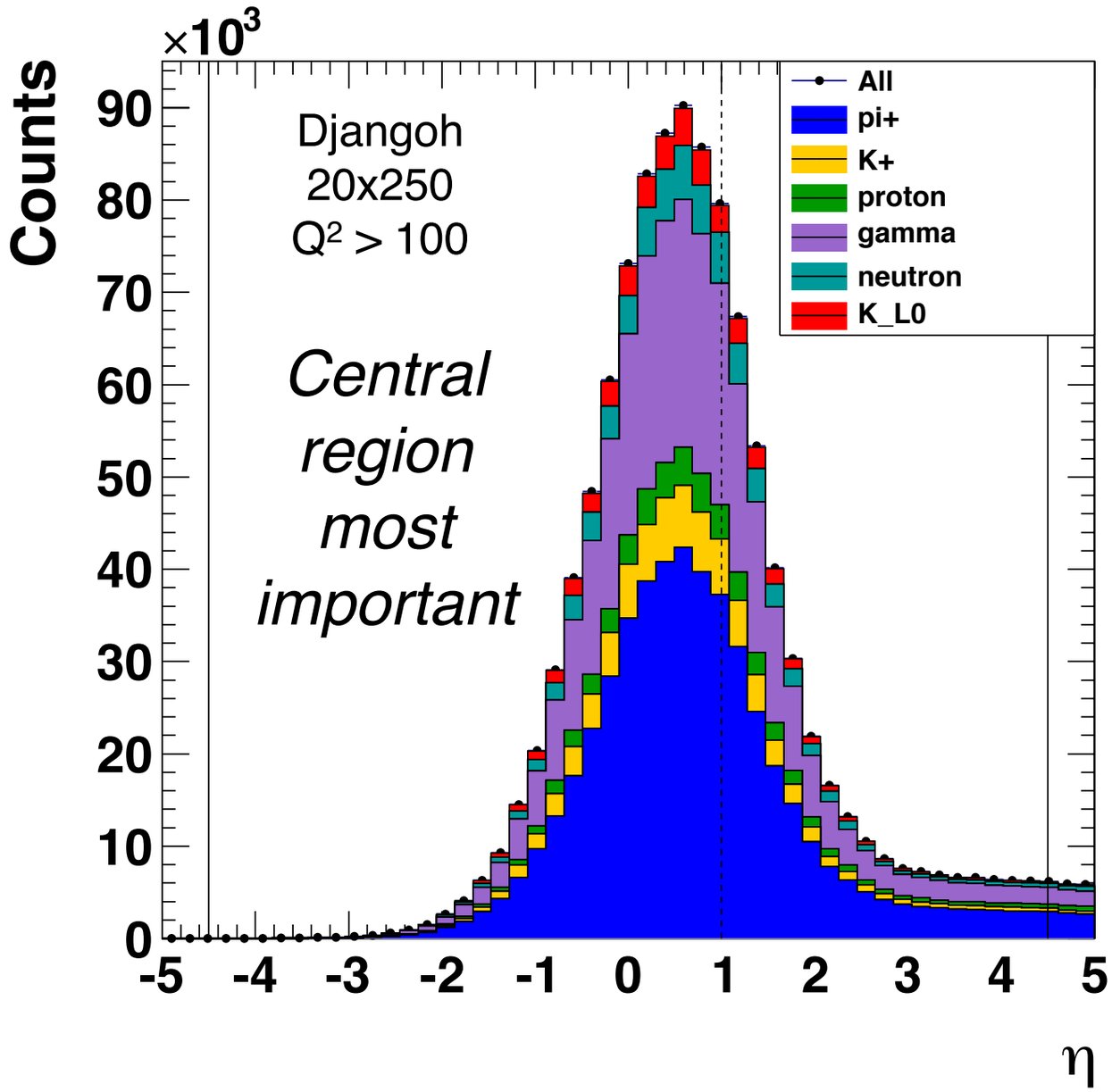
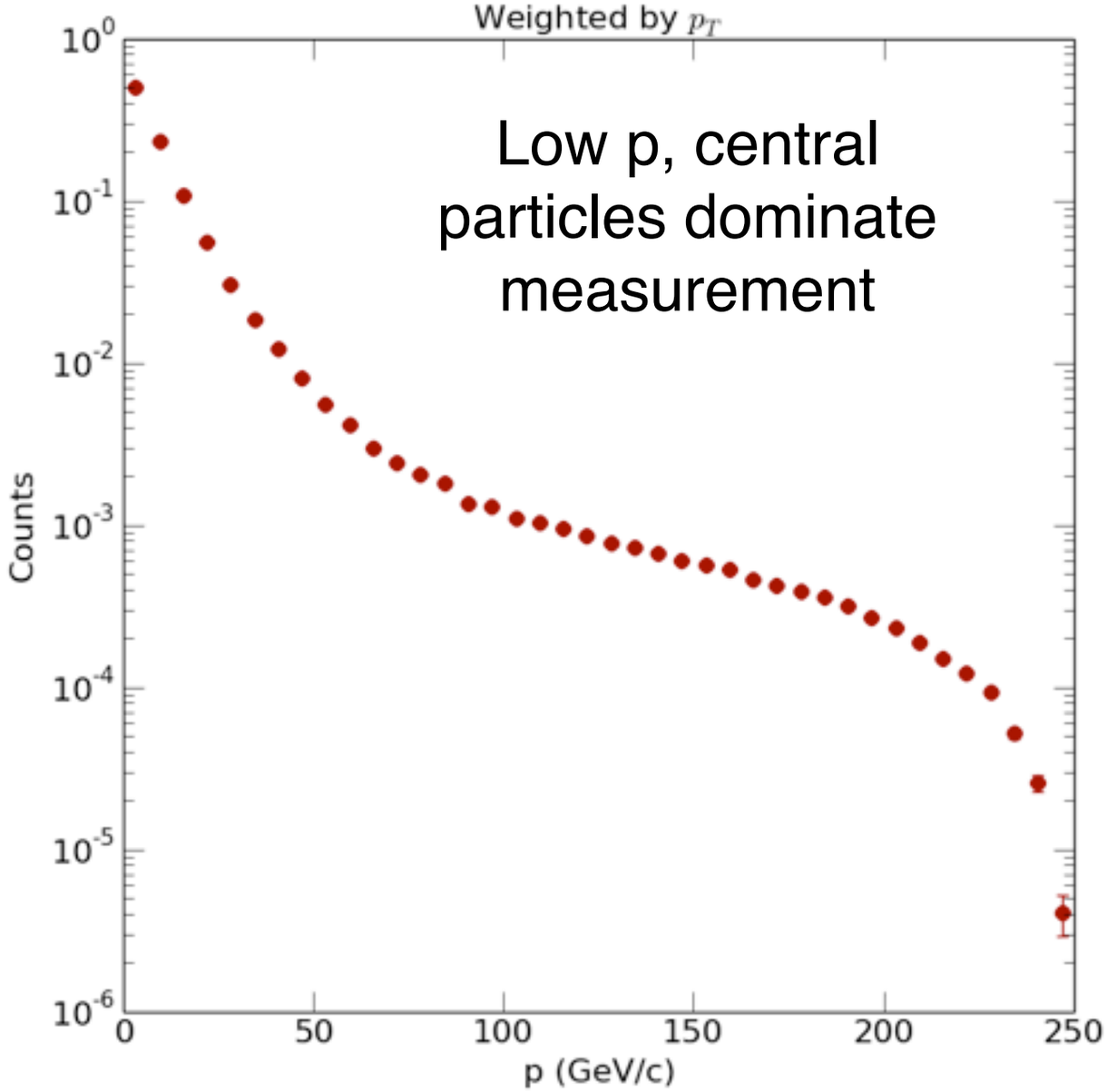
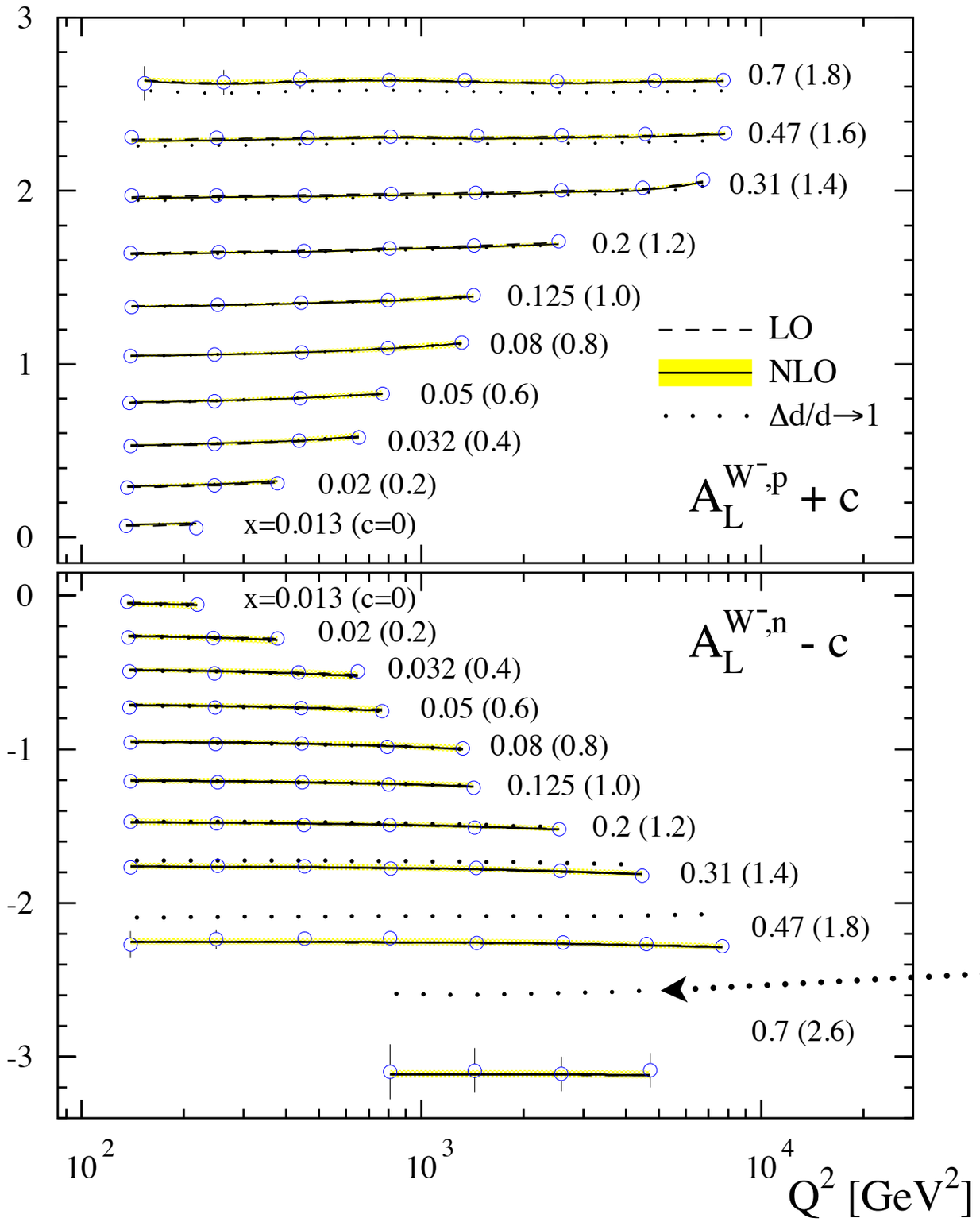




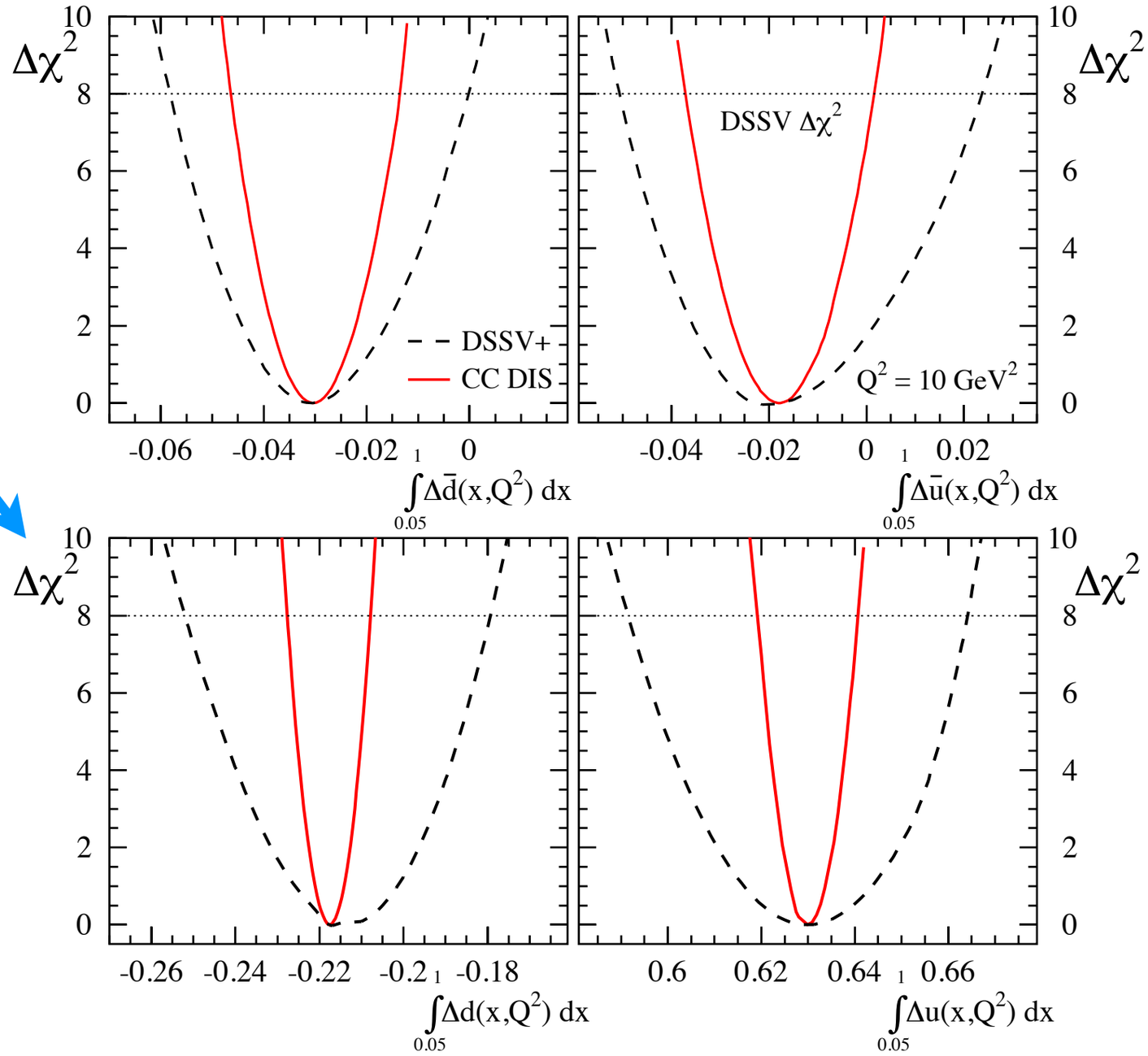
Asymmetries



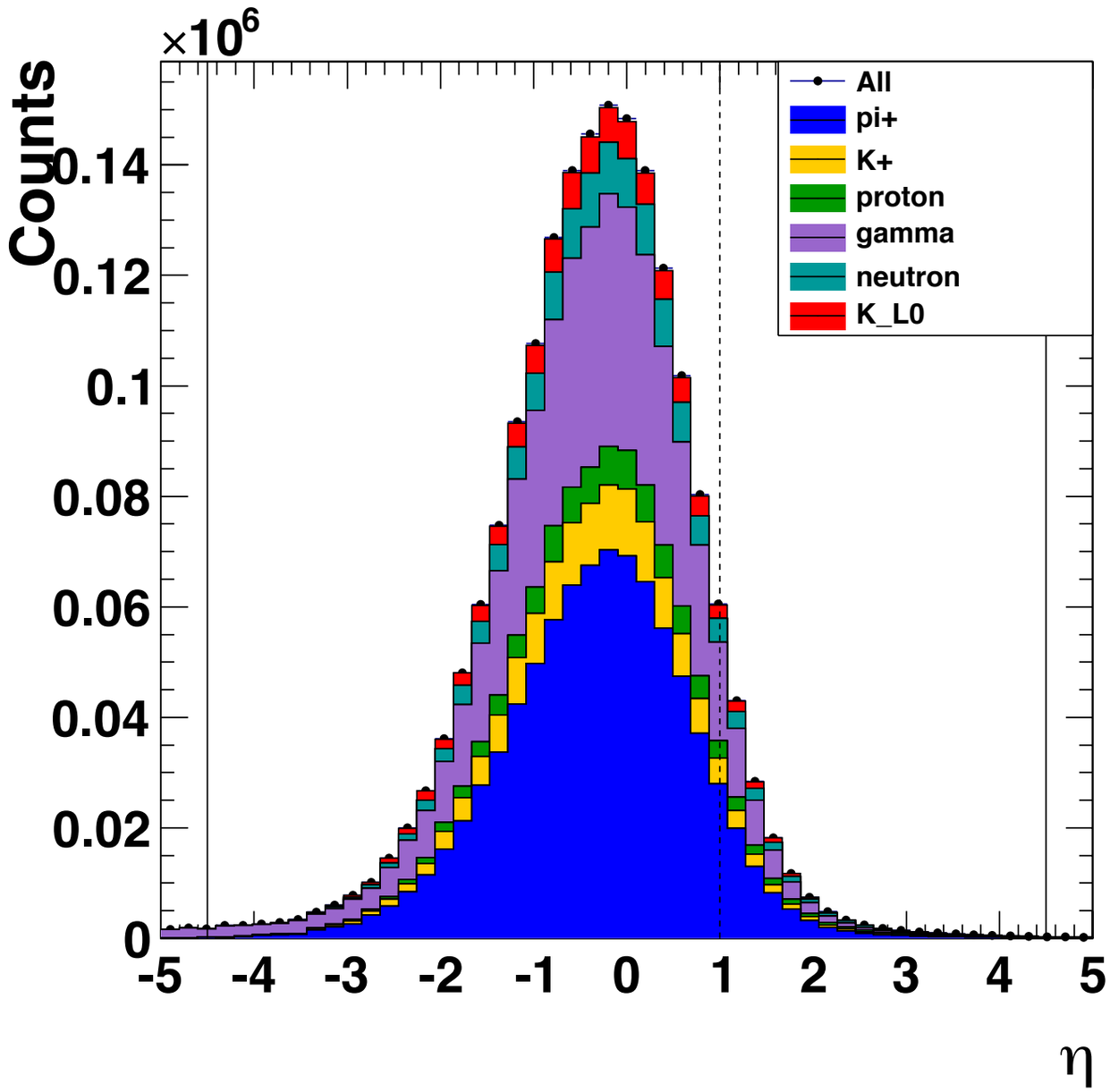
- Use counts remaining in correct bin after smearing/radiation, scale for 10 fb^{-1}
  - Very small uncertainties
- Small NLO effects
- Wide kinematic reach
- Sensitive to different large-x behaviour

Impact

- Significantly restricts χ^2 profiles
  - esp. **u** and **d**
  - Powerful complement to SIDIS and W
- Looks v. feasible with EIC
  - Worth looking at other CC measurements



counts weighted by ($E - p_z$):



- Forward region even less important for y
  - $y_{JB} \sim \text{sum}(E - p_z)$
- CME dependent:
  - lower E -> more to -η

Total cross section